

[JP,2004-179053,A]

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**Notes:**

1. Untranslatable words are replaced with asterisks (\*\*\*).
2. Texts in the figures are not translated and shown as it is.

Translated: 20:34:31 JST 09/09/2009

Dictionary: Last updated 08/17/2009 / Priority: 1. Electronic engineering / 2. Chemistry / 3. Technical term

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**FULL CONTENTS**

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**[Claim(s)]**

**[Claim 1]**

A bipolar electrode in which a positive active material layer is formed in one field of a charge collector, and it comes to form a negative electrode active material layer in a field of another side is a bipolar battery which it comes to laminate across a gel electrolyte layer,

It has a double-sided adhesive member arranged so that the circumference of cell layers constituted including said adjoining positive active material layer, said gel electrolyte layer, and said negative electrode active material layer may be surrounded,

A bipolar battery which said double-sided adhesive member consists of an insulation material which plays a role of a substrate, and an adhesive formed in both sides of this insulation material, and it is inserted between two charge collectors with said cell layers, and comes to paste this 2 \*\* charge collector with said adhesive.

**[Claim 2]**

The bipolar battery according to claim 1 which is 30 micrometers of errors to total thickness of cell layers by which total thickness of said insulation material inserted into two charge collectors and said adhesives is inserted into this 2 \*\* charge collector.

**[Claim 3]**

Said double-sided adhesive member,

Resin chosen from a group which becomes said substrate from polypropylene, polyethylene, and a polyamide synthetic fiber is used,

The bipolar battery according to claim 1 or 2 with which a synthetic rubber, butyl rubber, a synthetic resin, and material that has the solvent resistance chosen from a group which consists of acrylics are used for said adhesive.

**[Claim 4]**

A multiple oxide of lithium and transition metals is contained in said positive active material layer,

The bipolar battery according to any one of claims 1 to 3 with which a multiple oxide of carbon or lithium, and transition metals is contained in said negative electrode active material layer.

**[Claim 5]**

In the center of a charge collector, at least one of a positive active material layer, a gel electrolyte layer, and the negative electrode active material layers is laminated, and two or more single cells which laminate a double-sided adhesive member in which it comes to provide an adhesive to both sides of a

substrate and this substrate are further produced on the edge of said charge collector,

A manufacturing method of a bipolar battery on which single cells are pasted up with said adhesive of said double-sided adhesive member while laminating said single cell.

[Claim 6]

A cell group which connects two or more bipolar batteries of any one description of the Claims 1-4, or bipolar batteries which were manufactured by the manufacturing method according to claim 5 in parallel and/or in series.

[Claim 7]

Vehicles which carry a bipolar battery of any one description of the Claims 1-4, a bipolar battery manufactured by the manufacturing method according to claim 5, or the cell group according to claim 6 as a power supply for a drive.

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]

Especially this invention relates to the vehicles carrying the manufacturing method of the bipolar battery which used the polymer gel electrolyte for the electrolyte, and this bipolar battery, a cell group, and this bipolar battery about a bipolar battery.

[0002]

[Description of the Prior Art]

In a lithium secondary battery, there are a thing using the solid electrolyte as an electrolyte enclosed in it, a thing using a liquid electrolyte, and a thing using a polymer gel electrolyte.

[0003]

All the solid polymer electrolytes, such as polyethylene oxide, are used for a solid electrolyte, for example, and, on the other hand, an electrolytic solution is used for a liquid electrolyte 100%. A polymer gel electrolyte should also be called these middle and, for example, the very thing itself, such as polyvinylidene fluoride (PVDF), makes an electrolytic solution hold in the skeleton of a polymer without lithium ion conductivity (for example, refer to patent documents 1.).

[0004]

[Patent documents 1]

JP,H11-204136,A

[0005]

[Problem to be solved by the invention]

When cell layers were constituted using this polymer gel electrolyte, the plural laminates of these cell layers were carried out and a bipolar battery was manufactured, the electrolyte oozed out between each cell layers, and there was a problem that the short circuit of the cell layers which contact the electrolyte of other cell layers and are called liquid junction will occur.

[0006]

Then, the purpose of this invention is to provide the bipolar battery which prevented the liquid junction of cell layers, even when the plural laminates of the cell layers which used the polymer gel electrolyte are carried out and a battery is constituted.

[0007]

[Means for solving problem]

[ the bipolar electrode in which a positive active material layer is formed in one field of the 1st charge collector of this invention, and it comes to form a negative electrode active material layer in the field of

another side ] Said positive active material layer which is a bipolar battery which it comes to laminate across a gel electrolyte layer, and adjoins, Have a double-sided adhesive member arranged so that the circumference of the cell layers constituted including said gel electrolyte layer and said negative electrode active material layer may be surrounded, and, [ said double-sided adhesive member ] It is a bipolar battery which consist of an insulation material which plays the role of a substrate, and an adhesive formed in both sides of this insulation material, and it is inserted into two charge collectors with said cell layers, and comes to paste up with said adhesive between these 2 \*\* charge collectors.

[0008]

At least one of a positive active material layer, a gel electrolyte layer, and the negative electrode active material layers is laminated in the center of the 2nd charge collector of this invention, While producing two or more single cells which laminate a double-sided adhesive member by which it comes to provide an adhesive in both sides of a substrate and this substrate on the edge of said charge collector and laminating said single cell on it, it is a manufacturing method of a bipolar battery on which single cells are pasted up with said adhesive of said double-sided adhesive member.

[0009]

[Effect of the Invention]

When the double-sided adhesive member arranged so that the circumference of cell layers may be surrounded pastes up between two charge collectors according to the 1st bipolar battery of this invention, it plays the role of a sealing layer, The short circuit of the gel electrolyte of cell layers depended for beginning to leak can be prevented, and permeation of moisture from the outside, etc. can be prevented, in addition the intensity of the bipolar battery itself can be improved.

[0010]

Since according to the manufacturing method of the 2nd bipolar battery of this invention the single cell is produced previously, and a single cell is laminated and it pastes up later, it manufactures in large quantities, without taking into consideration the number of laminations of a bipolar battery at the time of manufacture of a single cell, and it is sufficient if a single cell required at the time of manufacture of an individual bipolar battery is prepared. Therefore, since it can divide into two steps called manufacture of a single cell, and manufacture of a bipolar battery, it can respond also to change of the number of laminations by a design variation flexibly, in addition working hours can be shortened.

[0011]

[Mode for carrying out the invention]

Hereafter, an embodiment of the invention is described with reference to Drawings. In the following Drawings, since explanation is clear, each component is exaggerated and expressed.

[0012]

(A 1st embodiment)

[ the bipolar electrode in which a positive active material layer is formed in one field of the 1st charge collector of this invention, and it comes to form a negative electrode active material layer in the field of another side ] Said positive active material layer which is a bipolar battery which it comes to laminate across a gel electrolyte layer, and adjoins, Have a double-sided adhesive member arranged so that the circumference of the cell layers constituted including said gel electrolyte layer and said negative electrode active material layer may be surrounded, and, [ said double-sided adhesive member ] It is a bipolar battery which consist of an insulation material which plays the role of a substrate, and an adhesive formed in both sides of this insulation material, and it is inserted into two charge collectors with said cell layers, and comes to paste up with said adhesive between these 2 \*\* charge collectors.

[0013]

At least one of a positive active material layer, a gel electrolyte layer, and the negative electrode active material layers is laminated in the center of the 2nd charge collector of this invention, While producing two or more single cells which laminate the double-sided adhesive member by which it comes to provide an adhesive in both sides of a substrate and this substrate on the edge of said charge collector and

laminating said single cell on it, it is a manufacturing method of the bipolar battery on which single cells are pasted up with said adhesive of said double-sided adhesive member.

[0014]

Drawing 1 is a sectional view for explaining the structure of the bipolar battery to which this invention is applied, and drawing 2 is a partial expanded sectional view of the electric cell which constitutes this bipolar battery.

[0015]

The positive active material layer 3 and the negative electrode active material layer 4 are formed in the center of both sides of one charge collector 2 other than both ends, and the bipolar battery 1 constitutes the cell layers 6 across the electrolyte layer 5 between the positive active material layer 3 of this charge collector 2, and the negative electrode active material layer 4, and has the structure where the plural laminates of these cell layers 6 were carried out. The charge collector (the end charge collector 7 is called) in both ends is connected with the electrode of this whole bipolar battery.

[0016]

And the composition which formed the positive active material layer 3 and the negative electrode active material layer 4 on both sides of the charge collector 2 is called bipolar electrode.

[0017]

Here, for example into a polymer skeleton, the electrolyte layer 5 is the gel electrolyte which made the electrolytic solution hold several percent of the weight - about 98weight %, and the gel electrolyte which held the electrolytic solution 70weight % or more can be used for it especially in this embodiment.

[0018]

In this bipolar battery 1, in order to prevent liquid leakage from the cell layers 6, the circumference of the one one cell layers 6 was surrounded, and the double-sided adhesive member 9 arranged between the charge collectors 2 or between the charge collector 2 and the end charge collector 7 is formed.

[0019]

The double-sided adhesive member 9 is a double-sided tape containing the substrate 10 and the adhesive 11 formed in both sides of this substrate 10. The substrate 10 is formed with insulating resin, such as polypropylene (PP), polyethylene (PE), and a polyamide synthetic fiber. The adhesive 11 is formed of material with solvent resistance, such as a synthetic rubber, butyl rubber, a synthetic resin, and an acrylic. By using such a material for the double-sided adhesive member 9, liquid leakage from the cell layers 6 can be prevented, and a short circuit by contact of charge collectors can be prevented.

[0020]

Next, a manufacture procedure of the bipolar battery 1 of this invention is explained.

[0021]

Drawing 3 - drawing 7 are the figures for explaining a manufacture procedure of a bipolar battery of this invention.

[0022]

The figure showing signs that drawing 3 laminates a gel electrolyte layer and a double-sided adhesive member on a charge collector, the figure showing signs that drawing 4 laminated the double-sided adhesive member, the A-A sectional view of the laminated material which shows drawing 4 drawing 5, the top view showing signs that drawing 6 laminates a single cell, and drawing 7 are the side views showing signs that a single cell is laminated.

[0023]

As a manufacture procedure of the bipolar battery 1 of this invention, as shown in drawing 3, first, an electrode layer (the positive active material layer 3 or the negative electrode active material layer 4 3, for example, a positive active material layer) is laminated on the end charge collector 7, and the gel electrolyte layer 5 is further laminated on it. And the double-sided adhesive member 9 is arranged on the edge of the end charge collector 7. Here, the penetration hole is formed in the center so that the double-sided adhesive member 9 may cover only the edge of the end charge collector 7.

[0024]

Thus, if it laminates to the double-sided adhesive member 9, as shown in drawing 4, the double-sided

adhesive member 9 will be arranged so that the surroundings of the gel electrolyte layer 5 may be surrounded. Here, since the adhesive 11 is formed in both sides, the double-sided adhesive member 9 is pasted up at the moment of laminating on the charge collector 7.

[0025]

The thickness of the double-sided adhesive member 9 is thicker than the thickness of the positive active material layer 3 and the gel electrolyte layer 5, as shown in drawing 5. It is desirable that it is less than  $\leq 30$  micrometers of the thickness of the sum total of the positive active material layer 3, the gel electrolyte layer 5, and the negative electrode active material layer 4 laminated behind, i.e., the thickness of the cell layers 6, as thickness of the double-sided adhesive member 9. By uniting the thickness of the double-sided adhesive member 9 with the total thickness of the cell layers 6, distortion of the charge collectors 2 and 7 accompanying the increase in the number of laminations can be prevented, and the reactant fall by distortion and a short circuit can be prevented. The width of about 5 mm of the double-sided adhesive member 9 is desirable from the request of a miniaturization of the bipolar battery 1.

[0026]

The end charge collector 7, the positive active material layer 3 and the gel electrolyte layer 5 which were laminated as mentioned above, and the double-sided adhesive member 9 are called the single cell 12.

About the single cell 13 located in the central part of the bipolar battery 1, what provided an electrode layer in both sides of the charge collector 2, for example, established the positive active material layer 3 in the upper surface, and established the negative electrode active material layer 4 in the undersurface is said. That is, let what laminated the gel electrolyte layer 5 on the negative electrode active material layer 4, the charge collector 2, and a bipolar electrode that laminates the positive active material layer 3, and laminated the double-sided adhesive member 9 on the edge of the charge collector 2 be the single cell 13. The bipolar battery 1 can be made into the desired number of laminations by increasing the number of laminations of the single cell 13.

[0027]

In the single cell 12 laminated to the above-mentioned beginning, the single cells 14 laminated at the last of the bipolar battery 1 differ, and say what laminated the end charge collector 7 to the negative electrode active material layer 4.

[0028]

Thus, the single cells 12-14 are made into one unit, two or more single cells are manufactured beforehand, and only the number required for the bipolar battery 1 is laminated. Signs that the single cells 12-14 are laminated are explained.

[0029]

As shown in drawing 6 and drawing 7, the single cell 13 of the central part is laminated to the first single cell 12. By repeating this, the number of laminations of the single cell 13 on the single cell 12 increases. When the single cell 13 is laminated to the single cell 12, the adhesive 11 of the double-sided adhesive member 9 of the single cell 12 pastes the undersurface of the charge collector 2 of the single cell 13. Similarly, when other single cells 13 are laminated on the single cell 13, the adhesive 11 of the lower single cell 13 pastes the undersurface of the charge collector 2 of the upper single cell 13. Thus, whenever the single cell 13 is laminated, it pastes up with the charge collector 2, and the double-sided adhesive member 9 seals the gel electrolyte layer 5. Thereby, liquid leakage from the gel electrolyte layer 5 can be prevented.

[0030]

Finally, as shown in drawing 7, the single cell 14 is laminated, and when the charge collector 7 of this single cell 14 pastes up with the double-sided adhesive member 9 of the single cell 13, the bipolar battery 1 is completed.

[0031]

As mentioned above. [ the bipolar battery 1 of this invention ] Since the double-sided adhesive member 9 was arranged between charge collectors so that these cell layers 6 might be enclosed with the cell layers 6, when the double-sided adhesive member 9 pastes up between two charge collectors, it can play the role of a sealing layer and the liquid leakage from the gel electrolyte layer 5 of the cell layers 6 can be

prevented. Therefore, the liquid junction by liquid leakage can also be prevented beforehand. In addition, by the double-sided adhesive member 9, permeation of moisture from the outside, etc. can be prevented and the intensity of the bipolar battery itself can be improved.

[0032]

Even when liquefaction of the gel electrolyte layer 5 takes place easily at 70 weight % or more in the rate of the electrolytic solution contained in the gel electrolyte layer 5, since there is no liquid leakage, liquid junction can be prevented.

[0033]

Since it is formed by lamination of the single cells 12-14, it manufactures in large quantities, without taking into consideration the number of laminations of the bipolar battery 1 at the time of manufacture of a single cell, and the bipolar battery 1 of this invention is sufficient if the single cells 12-14 required at the time of manufacture of the individual bipolar battery 1 are prepared. Therefore, since it can divide into two steps called manufacture of a single cell, and manufacture of the bipolar battery 1, it can respond also to change of the number of laminations by a design variation flexibly, in addition working hours can be shortened.

[0034]

About the above-mentioned bipolar battery 1, the member which constitutes batteries other than double-sided adhesive member 9 may be the same as what is used for the common rechargeable lithium-ion battery.

[0035]

Below, a charge collector, an anode, the negative electrode, a gel electrolyte, etc. which can be used for this bipolar battery 1 are explained.

[0036]

[Charge collector]

a charge collector -- thin film manufacturing technology, such as a process top and a spray coat, -- \*\*\*\* -- on the necessity that film production lamination is carried out and it can form also in what has shape [ like ], For example, metal powder, such as aluminum, copper, titanium, nickel, stainless steel (SUS), and these alloys, is used as the main ingredients. It heats and comes to fabricate the charge collector metal paste which contains a binder (resin) and a solvent in this, and comes to be formed with the above-mentioned metal powder and a binder. These metal powder may be used by an one-sort independent, two or more sorts may be mixed and used, and that from which the kind of metal powder differs taking advantage of the feature on a process may be further laminated to a multilayer.

[0037]

Especially as the above-mentioned binder, it should not be restricted, and conventionally publicly known resin binder materials, such as an epoxy resin, can be used, and also a conductive polymer may be used, for example.

[0038]

Although thickness in particular of a charge collector is not limited, it is usually about 1-100 micrometers.

[0039]

[A positive active material layer]

An anode contains positive active material. In addition, in order to improve ion conductivity, an electrolyte, lithium salt, etc. may be contained. In order to improve electron conductivity, azobisisobutyronitrile (azobisisobutyronitrile) etc. may be contained as NMP (N-methyl-2-pyrrolidone) and polymerization start material as an electric conduction assistant and an adjustment solvent of slurry viscosity. Although it is desirable especially an electrolyte and to contain a solid polymer electrolyte in either [ at least ] an anode or the negative electrode preferably, in order to raise the battery characteristic of a bipolar battery more, being contained to both sides is preferred.

[0040]

As the above-mentioned positive active material, a multiple oxide of transition metals and lithium in which a lithium ion battery of a solution system is also used can be used. Specifically, Li-Fe system multiple oxides, such as Li-Mn system multiple oxides, such as Li-nickel system multiple oxides, such as

Li-Co system multiple oxides, such as  $\text{LiCoO}_2$ , and  $\text{LiNiO}_2$ , and spinel  $\text{LiMn}_2\text{O}_4$ , and  $\text{LiFeO}_2$ , etc. are mentioned. In addition, a phosphoric acid compound and sulfated compound;  $\text{V}_2\text{O}_5$  of transition metals, such as  $\text{LiFePO}_4$ , and lithium, Transition metal oxides, such as  $\text{MnO}_2$ ,  $\text{TiS}_2$ ,  $\text{MoS}_2$ , and  $\text{MoO}_3$ , sulfide;  $\text{PbO}_2$ ,  $\text{AgO}$ ,  $\text{NiOOH}$ , etc. are mentioned.

[0041]

On a process, the particle diameter of positive active material carries out pasting of the positive electrode material, and just produces a film by a spray coat etc. In order to reduce the electrode resistance of a bipolar battery furthermore, it is good to use a thing smaller than the particle diameter which an electrolyte is used with the lithium ion battery of the solution type which is not a solid, and is generally used. Specifically, it is good in the mean particle diameter of positive active material being 10-0.1 micrometer.

[0042]

As an electrolyte contained in the above-mentioned anode, a solid polymer electrolyte, a polymer gel electrolyte, the thing that laminated these, etc. can be used. That is, an anode can also be made into multilayer structure and the electrolytic kind and the kind of active material which constitute an anode from a charge collector and electrolyte side, particle diameter, and the layer which changed these compounding ratios further can also be formed.

[0043]

Although a polymer gel electrolyte contains the electrolytic solution usually used for the solid polymer electrolyte which has ion conductivity with a lithium ion battery, the thing which made the same electrolytic solution hold is also further contained in the skeleton of a polymer without lithium ion conductivity.

[0044]

Here, [ as an electrolytic solution (electrolyte salt and plasticizer) contained in a polymer gel electrolyte ] Usually, [ that what is necessary is just what is used with a lithium ion battery ] For example,  $\text{LiPF}_6$ ,  $\text{LiBF}_4$ ,  $\text{LiClO}_4$ ,  $\text{LiAsF}_6$ ,  $\text{LiTaF}_6$ ,  $\text{LiAlCl}_4$ , Inorganic acid anionic salt, such as  $\text{Li}_2\text{B}_{10}\text{Cl}_{10}$ ,  $\text{LiCF}_3\text{SO}_3$ , . Are chosen from organic acid anionic salt, such as  $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$  and  $\text{Li}(\text{C}_2\text{F}_5\text{SO}_2)_2\text{N}$ . Including at least one kind of lithium salt (electrolyte salt), propylene carbonate, Cyclic carbonate, such as ethylene carbonate; Dimethyl carbonate, Chain carbonate, such as methylethyl carbonate and diethyl carbonate; Tetrahydrofuran, 2-methyltetrahydrofuran, 1,4-dioxane, 1, 2-dimethoxyethane, ether [ , such as 1,2-dibutoxy ethane, ]; -- lactone [ , such as gamma-butyrolactone ]; -- nitrile [ , such as acetonitrile ]; -- ester species [ , such as methyl propionate ]; -- amide [ , such as dimethylformamide ]; -- methyl acetate. The thing using organic solvents (plasticizer), such as an aprotic solvent, etc. which mixed one kind or two sorts or more as being chosen from methyl formate as it is few can be used. However, it is not necessarily restricted to these.

[0045]

As a polymer without the lithium ion conductivity used for a polymer gel electrolyte, polyvinylidene fluoride (PVDF), polyvinyl chloride (PVC), polyacrylonitrile (PAN), polymethylmethacrylate (PMMA), etc. can be used, for example. However, it is not necessarily restricted to these. Since it is a thing included in the category which does not rather almost have ion conductivity, it can also be considered as the polymer which has the above-mentioned ion conductivity, but PAN, PMMA, etc. are illustrated as a polymer without the lithium ion conductivity used for a polymer gel electrolyte here.

[0046]

As the above-mentioned lithium salt, for example  $\text{LiPF}_6$ ,  $\text{LiBF}_4$ ,  $\text{LiClO}_4$ ,  $\text{LiAsF}_6$ ,  $\text{LiTaF}_6$ , Organic acid anionic salt, such as inorganic acid anionic salt, such as  $\text{LiAlCl}_4$  and  $\text{Li}_2\text{B}_{10}\text{Cl}_{10}$ ,  $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$ , and  $\text{Li}(\text{C}_2\text{F}_5\text{SO}_2)_2\text{N}$ , or these mixtures can be used. However, it is not necessarily restricted to these.

[0047]

Acetylene black, carbon black, graphite, etc. are mentioned as an electric conduction assistant. However, it is not necessarily restricted to these.

[0048]

The loadings of the positive active material in an anode, an electrolyte (preferably solid polymer

electrolyte), lithium salt, and an electric conduction assistant should be determined in consideration of the purposes of using a battery (output serious consideration, energy serious consideration, etc.), and ion conductivity. For example, if there are too few loadings of the electrolyte in an anode, especially a solid polymer electrolyte, ionic conduction resistance and ion diffusion resistance within an active material layer will become large, and battery capacity will fall. On the other hand, if there are too many loadings of the electrolyte in an anode, especially a solid polymer electrolyte, the energy density of a battery will fall. Therefore, in consideration of these factors, the amount of solid polymer electrolytes corresponding to the purpose is determined.

[0049]

The thickness in particular of an anode should not be limited, and as loadings were described, it should be determined in consideration of the purposes of using a battery (output serious consideration, energy serious consideration, etc.), and ion conductivity. The thickness of a general positive active material layer is about 10-500 micrometers.

[0050]

[Negative electrode active material layer]

The negative electrode contains negative electrode active material. In addition, in order to improve ion conductivity, an electrolyte, lithium salt, an electric conduction assistant, etc. may be contained. Except the kind of negative electrode active material, since it is the same as that of the contents fundamentally indicated by the paragraph of the "positive active material layer", explanation is omitted here.

[0051]

As negative electrode active material, negative electrode active material in which a lithium ion battery of a solution system is also used can be used. For example, a metal oxide, lithium metal multiple oxide metal, carbon, etc. are preferred. They are carbon, a transition metal oxide, and a lithium transition-metals multiple oxide more preferably. They are titanium oxide, a lithium titanium multiple oxide, and carbon still more preferably. These may be used by an one-sort independent and may use two or more sorts together.

[0052]

[An electrolyte]

As an electrolyte, it is a polymer gel electrolyte. This electrolyte can also be made into multilayer structure, is with the anode and negative electrode side, and can also form a layer which changed an electrolytic kind and a component formulation ratio. When using a polymer gel electrolyte, ratios (mass ratio) of polymer and an electrolytic solution which constitute this polymer gel electrolyte are 20:80-2:98, and a range with a comparatively large ratio of an electrolytic solution.

[0053]

Although an electrolytic solution usually used for a solid polymer electrolyte which has ion conductivity with a lithium ion battery as such a polymer gel electrolyte is included, a thing which made same electrolytic solution hold, and a thing contained are further contained in a skeleton of a polymer without lithium ion conductivity. About these, since it is the same as that of a polymer gel electrolyte explained as one sort of an electrolyte contained in a [anode], explanation here is omitted.

[0054]

These solid polymer electrolytes or a polymer gel electrolyte may be contained also in an anode and/or the negative electrode as everything but polyelectrolyte which constitutes a battery was described above, but. [ a polymer gel electrolyte ] Polyelectrolyte which changes with polyelectrolyte, anodes, and the negative electrodes which constitute a battery may be used, the same polyelectrolyte may be used and polyelectrolyte which changes with layers may be used.

[0055]

Thickness in particular of an electrolyte which constitutes a battery is not limited. However, in order to obtain a compact bipolar battery, it is preferred to make it thin as much as possible in the range which can secure a function as an electrolyte. Thickness of a general solid polymer electrolyte layer is about 10-100 micrometers. However, it is also easy to form taking advantage of the feature on a process, so that the upper surface and a side peripheral part of an electrode (an anode or the negative electrode) may also be



covered, it is not necessary to depend it on a part also from a function and a performance side, and the electrolytic shape does not always have to make it approximately regulated thickness.

[0056]

[Battery exterior cases (cell case)]

A bipolar battery is good to accommodate the whole battery layered product including a template which is a main part of a bipolar battery in battery exterior cases thru/or a cell case (not shown), in order to prevent a shock from the outside at the time of using it in order to prevent a shock from the outside, and environmental degradation, and environmental degradation.

[0057]

A polymer-metal composite laminate film, an aluminum laminated pack, etc. which covered metal (an alloy is included), such as aluminum, stainless steel, nickel, and copper, with insulators, such as a polypropylene film, from a viewpoint of a weight saving, It is preferred by joining a part or all of the periphery in thermal melting arrival using publicly known battery exterior cases conventionally to have composition which stored and sealed the battery layered product.

[0058]

In this case, the above-mentioned anode and a negative electrode lead should just be taken as the structure which is inserted into the above-mentioned heat sealed part, and is exposed to the exterior of the above-mentioned battery exterior cases. It is preferred to use the polymer-metal composite laminate film excellent in thermal conductivity, an aluminum laminated pack, etc. at the point that heat can be efficiently told from the heat source of a car, and the inside of a battery can be quickly heated to battery operation temperature.

[0059]

[An anode and a negative pole terminal board]

As for each of the electrodes and electrolytes which film production comes to laminate, and charge collectors, although an anode and a negative pole terminal board have a function as a terminal and also their thinner one as much as possible is good from a viewpoint of slimming down, since mechanical strength is weak, it is desirable to give only the intensity which carries out \*\*\*\*\* support of these from both sides. The thickness of an anode and a negative pole terminal board can be said for about 0.1-2 mm to be usually desirable from a viewpoint of stopping the internal resistance in a terminal area.

[0060]

The quality of the material usually used with a lithium ion battery can be used for the quality of the material of an anode and a negative pole terminal board. For example, aluminum, copper, titanium, nickel, stainless steel (SUS), these alloys, etc. can be used. It is preferred to use aluminum from viewpoints of corrosion resistance, the ease of making, economical efficiency, etc.

[0061]

The same quality of the material may be used for the quality of the material of a positive pole terminal board and a negative pole terminal board, and a thing of the different quality of the material may be used for it. These anodes and a negative pole terminal board may laminate to a multilayer that from which the quality of the material differs.

[0062]

What is necessary is for the shape of an anode and a negative pole terminal board just to be the shape which traced the charge collector external surface in which this terminal assembly is installed, and to trace it in shape which traced the heat source external surface of a car, etc. by press forming etc., and just to form it in it with a terminal assembly provided in a position which carries out a counter electrode to a template again, when using also as a template. In a terminal assembly provided in a position which carries out a counter electrode to a template, it may form by a spray coat like a charge collector.

[0063]

[An anode and a negative electrode lead]

About an anode and a negative electrode lead, a publicly known lead usually used with a lithium ion battery can be used. Since a portion taken out from battery exterior cases (cell case) does not have distance with a heat source of a car, it is preferred to cover with a heat shrinkable tube of heat-resistant

insulation, etc. so that these may be contacted, it may be short-circuited and autoparts (especially electronic equipment) may not be affected.

[0064]

Drawing 8 is Drawings in which appearance when an aluminum laminated pack constitutes the bipolar battery 1 shown in drawing 1 and 2 as the battery 20 is shown. This battery 20 forms an above-mentioned anode and negative pole terminal board in the end charge collector 7 of the bipolar battery 1, attaches a lead further, and is using it as the electrodes 23 and 24.

[0065]

Next, the example of an experiment which evaluated by manufacturing the account bipolar battery 1 in practice is explained.

[0066]

The example of an experiment

<Liquid junction evaluation>

The bipolar battery 1 was manufactured like the embodiment mentioned above, and the liquid junction of electric cells was evaluated.

[0067]

(Sample production)

The bipolar battery 1 actually produced as an embodiment is as follows.

[0068]

20-micrometer stainless steel (SUS) foil was used for the charge collector 2, it formed the positive active material layer 3 or the negative electrode active material layer 4 in the end charge collector 7, and formed the positive active material layer 3 and the negative electrode active material layer 4 in the charge collector 2.

[0069]

To  $\text{LiMn}_2\text{O}_4$  the positive active material layer 3 as an electric conduction assistant Acetylene black, Mix N-methyl-2-pyrrolidone (NMP) as polyvinylidene fluoride (PVDF) and a viscosity control solvent as a binder, produce anode slurry, and this is made into positive active material, It applies to one side of the stainless steel foil (20 micrometers in thickness) which is a charge collector, it is dried, and it is considered as the positive active material layer 3 of 40 micrometers of thickness.

[0070]

To  $\text{Li}_4\text{Ti}_5\text{O}_{12}$  the negative electrode active material layer 4 as an electric conduction assistant Acetylene black, Mix, produce negative electrode slurry, the opposite side of NMP and the stainless steel foil which applied the positive active material layer 3 is made to apply and dry this negative electrode slurry as PVDF and a viscosity control solvent as a binder, and it is considered as the negative electrode active material layer 4 of 50 micrometers of thickness.

[0071]

The polymer gel electrolyte layer 5, [ 100-micrometer-thick polypropylene (PP) non-\*\*\*\* ] 5 weight % of polymer (copolymer of polyethylene oxide and polypropylene oxide),  $\text{Li}(\text{C}_2\text{F}_5\text{SO}_2)_2\text{N}$  of 1.0 mol/l and the gel electrolyte, \*\* and others, are made to hold to 95 weight % of ethylene carbonate (EC)+ dimethyl carbonate (DMC) of the mixing ratio 1:3, and an EC+DMC electrolytic solution.

[0072]

The double-sided adhesive member 9 used polypropylene (PP) for the substrate 10, used the synthetic rubber for the adhesive 11, and prepared the thing (5 mm in width, and 190 micrometers in thickness).

[0073]

making the number of laminations of the cell layers 6 into five layers -- the time of lamination of the single cells 12-14 -- the adhesive 11 of the double-sided adhesive member 9 -- between each single cell -- adhesion -- and the ceiling was carried out.

[0074]

it does not have the double-sided adhesive member 9 as a comparative example of this evaluation -- the pie Poral battery of structure was formed similarly.

[0075]

Evaluation of liquid junction was evaluated by doing the charge-and-discharge cycle test of the bipolar battery 1 of an embodiment and a comparative example. It charged with the current of 0.5C, and the cycle of charge and discharge discharged with the current of 0.5C, and made this one cycle.

[0076]

(Evaluation result)

In the bipolar battery 1 of the embodiment, liquid junction (short circuit) inter-electrode in 50 cycle super-\*\*\*\* did not happen a charging and discharging cycle, but output voltage was maintained.

[0077]

On the other hand, in the bipolar battery 1 of the comparative example, while charging the first time, the electrolytic solution oozed out out of cell layers, the electrolyte layer 5 of other cell layers was contacted, liquid junction happened, and cell voltage fell remarkably.

[0078]

It turns out that the liquid junction of electric cells can be certainly prevented by forming the double-sided adhesive member 9 which encloses this every cell layers 6 from this evaluation result.

[0079]

<A thickness examination of the double-sided adhesive member 9>

Next, it examined by changing thickness of the double-sided adhesive member 9.

[0080]

(Sample production)

The bipolar battery 1 produced as an embodiment is the same structure as the above <liquid junction evaluation>. Thickness of the double-sided adhesive member 9 which a bipolar battery of an embodiment has is 190 micrometers in all at total thickness of the thickness 3 (40 micrometers) of the cell layers 6, i.e., a positive active material layer, the gel electrolyte layer 5 (100 micrometers), and the negative electrode active material layer 4 (50 micrometers).

[0081]

As a comparative example of evaluation, a bipolar battery with which only thickness of the double-sided adhesive member 9 differs was produced. As the comparative examples 1-6, a bipolar battery (100 micrometers, 120 micrometers, 160 micrometers, 220 micrometers, 260 micrometers, and 300 micrometers) was produced for thickness of the double-sided adhesive member 9 in order.

[0082]

About a bipolar battery of an embodiment and the comparative examples 1-6, evaluation of thickness repeated a charging and discharging cycle 10 times, and measured electric discharge capacity of 10 cycle eye, respectively. It charged with current of 0.5C, and a cycle of charge and discharge discharged with current of 0.5C, and made this one cycle.

[0083]

(Evaluation result)

Drawing 9 is a figure showing an evaluation result about electric discharge capacity to thickness of a double-sided adhesive member. By drawing 9, electric discharge capacity of 10 cycle eye of a bipolar battery (190 micrometers in thickness) of an embodiment is made into 100%, and electric discharge capacity of a comparative example is shown. As shown in drawing 9, in the comparative example 3 and the comparative example 4, electric discharge capacity was comparatively large, and electric discharge capacity fell remarkably in the comparative examples 1, 2, 5, and 6.

[0084]

Electric discharge capacity is so good that the thickness of the double-sided adhesive member 9 is close to the thickness of the cell layers 6, and to the thickness of cell layers, this evaluation result shows that the performance of a battery can be maintained, if the thickness of the double-sided adhesive member 9 is about 30 micrometers of errors.

[0085]

(A 2nd embodiment)

The 3rd of this invention is a cell group which connects two or more bipolar batteries 1 of a 1st embodiment of the above in parallel and/or in series.

[0086]

Drawing 10 is a perspective view of the cell group by a 2nd embodiment, and drawing 11 is the Drawings which looked at the internal configuration from the upper part.

[0087]

the battery 20 (refer to drawing 8) which packed the bipolar battery 1 by a 1st embodiment that mentioned the cell group 50 above as shown in drawing 10 and drawing 11 by the laminated pack -- the thing directly connected [ two or more ] is connected still in parallel. The electrodes 23 and 24 of each battery are connected to battery 20 comrades by the electric conduction bar 53. The electrode terminals 51 and 52 are established in the 1 side of the cell group 50 as an electrode of this cell group 50 at this cell group 50.

[0088]

In this cell group, ultrasonic welding, hot welding, laser welding, a rivet, caulking, an electron beam, etc. can be used as a connection method at the time of connecting the battery 20 directly and connecting still in parallel. By taking such a connection method, a cell group with long-term reliability can be manufactured.

[0089]

According to the cell group by a 2nd embodiment, by cell-group-izing using the battery by a 1st embodiment mentioned above, it can obtain with high capacity and high power, and moreover, since the reliability of one one battery is high, the long-term reliability as a cell group can be raised.

[0090]

Connection of the battery 20 as a cell group may connect two or more batteries 20 to parallel altogether, and may connect two or more batteries 20 to series altogether.

[0091]

(A 3rd embodiment)

The 4th of this invention is vehicles which carry the bipolar battery 1 of a 1st embodiment of the above, or the cell group 50 of a 2nd embodiment as a power supply for a drive. As vehicles using the bipolar battery 1 or the cell group 50 as a power supply for motors, they are cars which are driving the wheel by the motor, such as an electric vehicle and a hybrid car, for example.

[0092]

By reference, the schematic diagram of the car 100 carrying the cell group 50 is shown in drawing 12. The cell group 50 carried in a car has the characteristics which explained [ above-mentioned ]. For this reason, the car carrying the cell group 50 has high endurance, and even if it is after using it over a long period of time, it can provide sufficient output.

[Brief Description of the Drawings]

[Drawing 1] It is a sectional view for explaining the structure of the bipolar battery to which this invention is applied.

[Drawing 2] It is a partial expanded sectional view of the electric cell which constitutes this bipolar battery.

[Drawing 3] It is a figure showing signs that a gel electrolyte layer and a double-sided adhesive member are laminated on a charge collector.

[Drawing 4] The figure showing signs that the double-sided adhesive member was laminated, and drawing 5 are the fragmentary sectional views of the laminated material shown in drawing 4.

[Drawing 5] It is an A-A sectional view of the laminated material shown in drawing 4.

[Drawing 6] It is a top view showing signs that a single cell is laminated.

[Drawing 7] It is a side view showing signs that a single cell is laminated.

[Drawing 8] It is a perspective view showing the appearance of the battery which made the bipolar battery the laminated pack.

[Drawing 9] It is a figure showing the evaluation result about electric discharge capacity to the thickness of a double-sided adhesive member.

[Drawing 10] It is a perspective view of a cell group.

[Drawing 11] They are the Drawings which looked at the internal configuration of the cell group from the

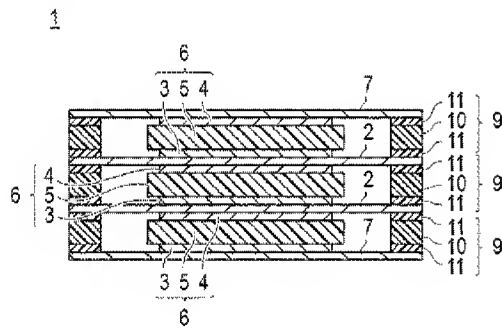
upper part.

[Drawing 12] It is a schematic diagram of the car carrying a cell group.

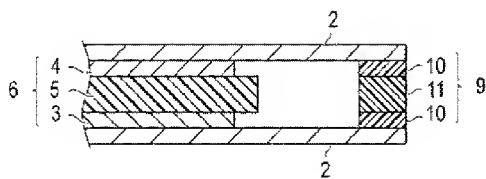
[Explanations of letters or numerals]\*\*

- 1 -- Bipolar battery
- 2 -- Charge collector,
- 3 -- Positive active material layer,
- 4 -- Negative electrode active material layer,
- 5 -- Gel electrolyte layer
- 6 -- Cell layers,
- 7 -- End charge collector,
- 9 -- Double-sided adhesive member,
- 10 -- Substrate,
- 11 -- Adhesive,
- 12-14 -- Single cell
- 50 -- Cell group,
- 100 -- Car.

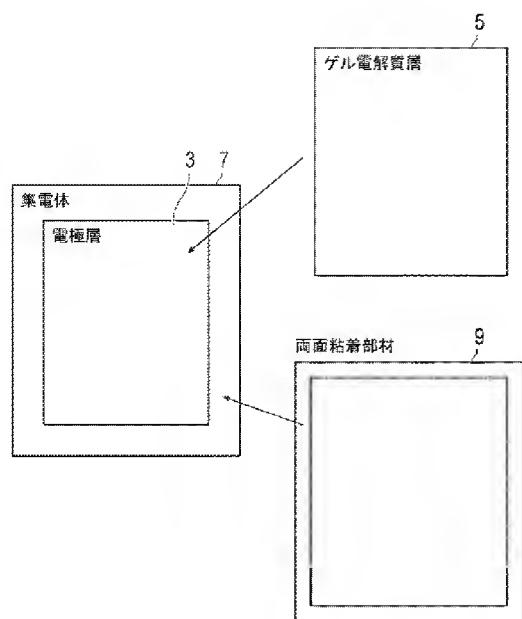
[Drawing 1]



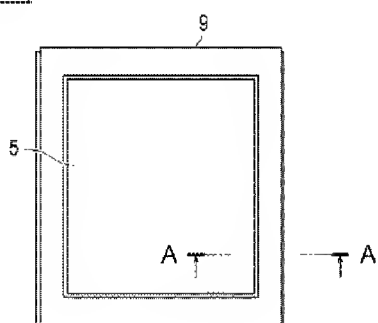
[Drawing 2]



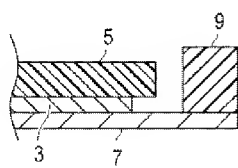
[Drawing 3]



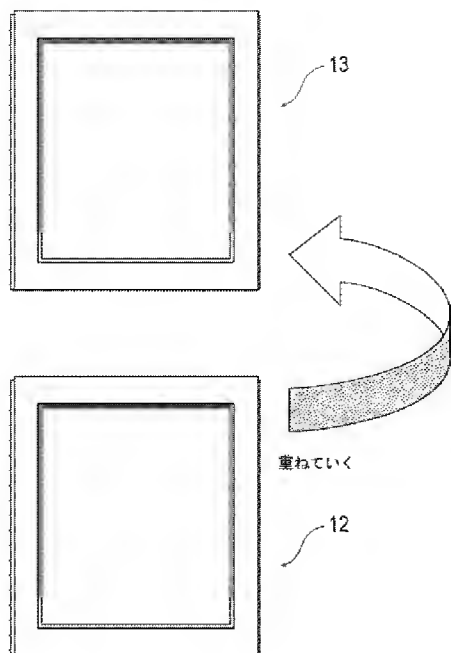
[Drawing 4]



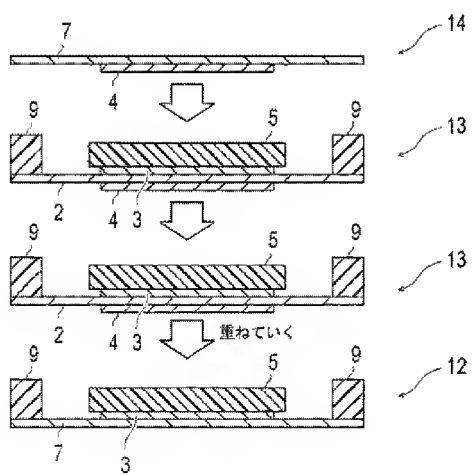
[Drawing 5]



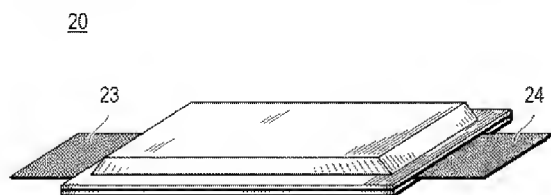
[Drawing 6]



[Drawing 7]



[Drawing 8]

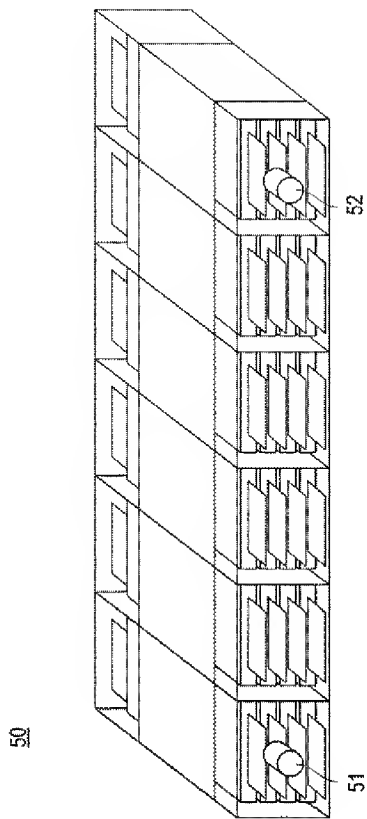


[Drawing 9]

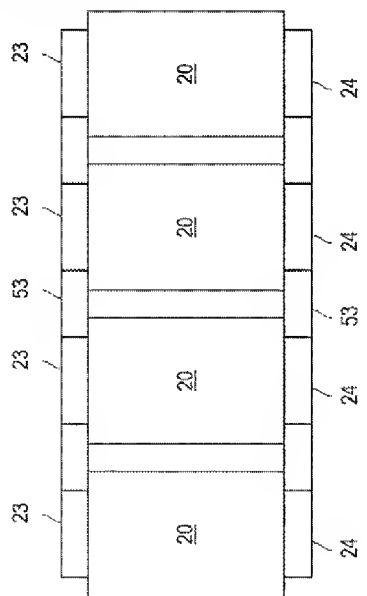
	比較例 1	比較例 2	比較例 3	実施例	比較例 4	比較例 5	比較例 6
凹部テーパーの厚さ ( $\mu\text{m}$ )	100	120	160	190	220	260	300
10サイクル目の放電容量 (%)	70	85	98	100	92	71	65

[Drawing 10]

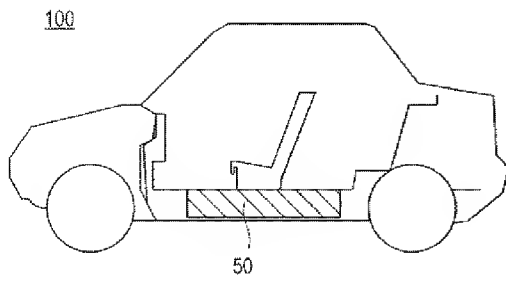




[Drawing 11]



[Drawing 12]



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[Translation done.]